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MECHANICS.

276. Proposed by V. M. SPUNAR, Chicago, Illinois.

Find the center of gravity of the volume formed by the revolution around the x-axis of the area of the curve $y^4 - axy^2 + x^4 = 0$.

SOLUTION BY RICHARD MORRIS, Rutgers College.

From

$$y^2 = \frac{ax \pm x\sqrt{a^2 - 4x^2}}{2},$$

we find the x limits to be 0 and $a/2$.

Hence

$$\bar{x} = \frac{\int_0^{a/2} \pi(y_1^2 - y_2^2)x dx}{\int_0^{a/2} \pi(y_1^2 - y_2^2) dx}$$

or

$$\bar{x} = \frac{\int_0^{a/2} \left[\frac{ax + x\sqrt{a^2 - 4x^2} - ax + x\sqrt{a^2 - 4x^2}}{2}\right] xdx}{\int_0^{a/2} \left[\frac{ax + x\sqrt{a^2 - 4x^2} - ax + x\sqrt{a^2 - 4x^2}}{2}\right] dx} = \frac{\int_0^{a/2} x^2(a^2 - 4x^2)^{\frac{1}{2}} dx}{\int_0^{a/2} (a^2 - 4x^2)^{\frac{1}{2}} x dx}.$$

Putting $2x = z$, and transforming the numerator only, we get

$$\bar{x} = \frac{\int_0^{a} \frac{1}{8} z^2(a^2 - z^2)^{\frac{1}{2}} dz}{\int_0^{a/2} (a^2 - 4x^2)^{\frac{1}{2}} x dx},$$

which easily integrates by means of tables, giving

$$\bar{x} = \frac{\frac{1}{8}\left[\frac{z}{8}(2z^2 - a^2)\sqrt{a^2 - z^2} + \frac{a^4}{8}\sin^{-1}\frac{z}{a}\right]_0^a}{-\frac{1}{8}\left[(a^2 - 4x^2)^{\frac{3}{2}} \cdot \frac{2}{3}\right]_0^{a/2}} = \frac{3a\pi}{32}.$$

Also solved by S. W. REAVES and H. E. TREFETHEN.

280. Proposed by C. N. SCHMALL, New York City.

Given the distance d between two smooth hooks in the same horizontal line. Show that the shortest string which can form a catenary, with these hooks for points of support, is de where e is the base of the Naperian system of logarithms.

SOLUTION BY A. M. HARDING, University of Arkansas.

Let $y = c/2(e^{\frac{x}{c}} + e^{-\frac{x}{c}})$ be the catenary. Let $BC = l$, then $W = wl$, where w = weight per unit length of the string. The tension at any given point of the catenary is given by $T \sin \theta = ws$, where s = the length of the string measured